City Pacific Limited

TOWNSVILLE OCEAN TERMINAL - SUPPLEMENTARY REPORT: GASEOUS EMISSIONS

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CONTENTS

1 INTRODUCTION

1.1 OVERVIEW

Air Noise Environment Pty Ltd (ANE) were commissioned by City Pacific Limited to undertake an air quality assessment for the Townsville Ocean Terminal (TOT) development proposed to be constructed in Townsville.

The proposal will provide Townsville with:

- a dedicated cruise terminal and wharf for cruise ships and military vessels, located on the Port Western Breakwater, adjacent to the Port of Townsville;
- an integrated residential and tourism development providing residential land parcels of mixed density for development;
- extended public access to the Breakwaters and provide future open space areas to land to be reclaimed to the north of the existing Townsville Hotel and Casino Complex and the Townsville Entertainment Centre; and
- increased marina berths for the marine industry, general recreational vessels, and provide berthing facilities for superyachts.

The Air Quality Assessment (AQA) undertaken by ANE[1] and included in the Environmental Impact Statement (EIS) for the Project incorporated modelling of future emissions from the Port of Townsville. In addition, monitoring of existing air quality at (or near) the Project Site was undertaken for a range of determinants including oxides of nitrogen, sulphur dioxide, organic hydrocarbons and deposited dust. Monitoring data collected by the Queensland Environmental Protection Agency (EPA) and the Townsville Port Authority (TPA) was also considered in the assessment.

This supplementary report presents the complete results of the gaseous monitoring program undertaken for the TOT project.

1.2 THIS REPORT

This report provides a summary of the results of deposited dust monitoring undertaken in the area and forms part of the following series of supplementary air quality assessment reports prepared for the project:

- Townsville Ocean Terminal: Supplementary Report - Responses to EIS Comments
- Townsville Ocean Terminal: Supplementary Report – Suspended Particulates
- Townsville Ocean Terminal: Supplementary Report – Deposited Dust
- Townsville Ocean Terminal: Supplementary Report – Metals Emissions

[1] *Townsville Ocean Terminal – Air Quality Assessment (October 2007) prepared by Air Noise Environment Pty Ltd on behalf of City Pacific Limited*

2 ASSESSMENT CRITERIA

The Terms of Reference for the project EIS nominated the following air quality criteria:

- The National Health and Medical Research Council (NHMRC) national guidelines (1985) for control of emissions from stationary sources.
- Environmental Protection Air Policy (1997) (EPP Air) and the Environmental Protection Act (1994).
- National Environmental Protection Measure (NEPM) for Ambient Air Quality (1998).

The Project does not include stationary sources (e.g. industrial stacks), hence application of the NHMRC criteria is not relevant.

For the assessment of the impacts of gaseous emissions on the proposed development, Table 2.1 provides a summary of the criteria and sources of the criteria utilised in the assessment. Where different air quality goals are nominated in the State legislation and the National Environmental Protection Measure (NEPM), both are referenced.

Table 2.1: SUMMARY OF ADOPTED AIR QUALITY CRITERIA

Pollutant	Averaging Period	Criteria (µg/m^3)	Source
Carbon monoxide	8 hours	10,000	EPP Air
Nitrogen Dioxide	1 hour 1 year	246 63	NEPM NEPM
Sulphur Dioxide	1 hour 1 day 1 year	570 228 57	EPP Air NEPM NEPM

3 GASEOUS AIR MONITORING

3.1 OVERVIEW

This section of the report provides a summary of all gaseous air monitoring data collected by Project specific monitoring stations by the Project Team. The data presented includes data collected and reported in the AQA along with additional data collected following submission of the AQA.

3.2 METEOROLOGICAL CONDITIONS

3.2.1 Typical Townsville Meteorology

The climatology in the Townsville area is typical of a tropical environment, however, due to its geographical location, rainfall is not as high as elsewhere in the tropics. Winter months are dominated by SE trade winds and mostly fine weather. The summer months are hot and humid with "build-up" thunderstorms starting in late October or November. Bursts of monsoon rains from late December through until early April deliver the highest rainfall.

Figure 1 presents a wind rose for the Townsville Port Authority meteorological station located at Berth 10 of the Port of Townsville (located to the east of the Project Site) for the period January 2004 – December 2006.

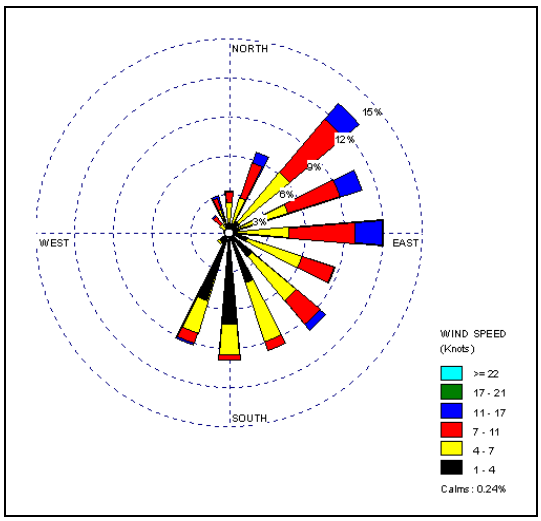

Figure 1: Windrose for Townsville Port Berth 10 Monitoring Station (2004 – 2007)

Winds are noted to be predominantly easterly and north-easterly during the wet season and easterly to south south westerly in the dry season. For all periods the occurrence of calms in the Project Site area is low with less than 1 % calms recorded in any season of available monitoring data.

The average annual rainfall recorded at the Bureau of Meteorology monitoring station located at Townsville Airport is 1143 mm for an average of 91 rain days, most of which falls in the six month "wet season" November to April. Figure 2 presents a summary of average rainfall per month across a typical year.

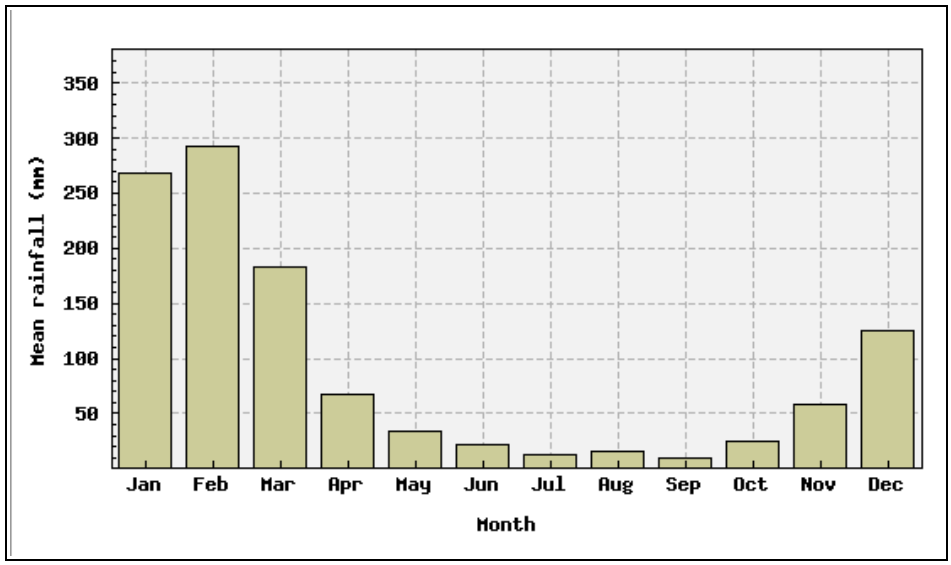

Figure 2: Typical Rainfall Patterns for Townsville Region (average over all years of recorded data)

3.2.2 Meteorological Conditions During Monitoring

Figure 3 presents a summary of wind conditions during the continuous monitoring at the Berth 10 monitoring station. Review of this data confirms that for the majority of the monitoring period, winds were from easterly sectors. Thus, for much of the monitoring period, winds were blowing from the major sources at the Port to the monitoring station. Furthermore, comparison of the wind direction and speed profiles against those for the 2004 – 2006 period confirm that the winds experienced throughout the three months of gaseous monitoring are typical of those experienced at the Project Site throughout the year.

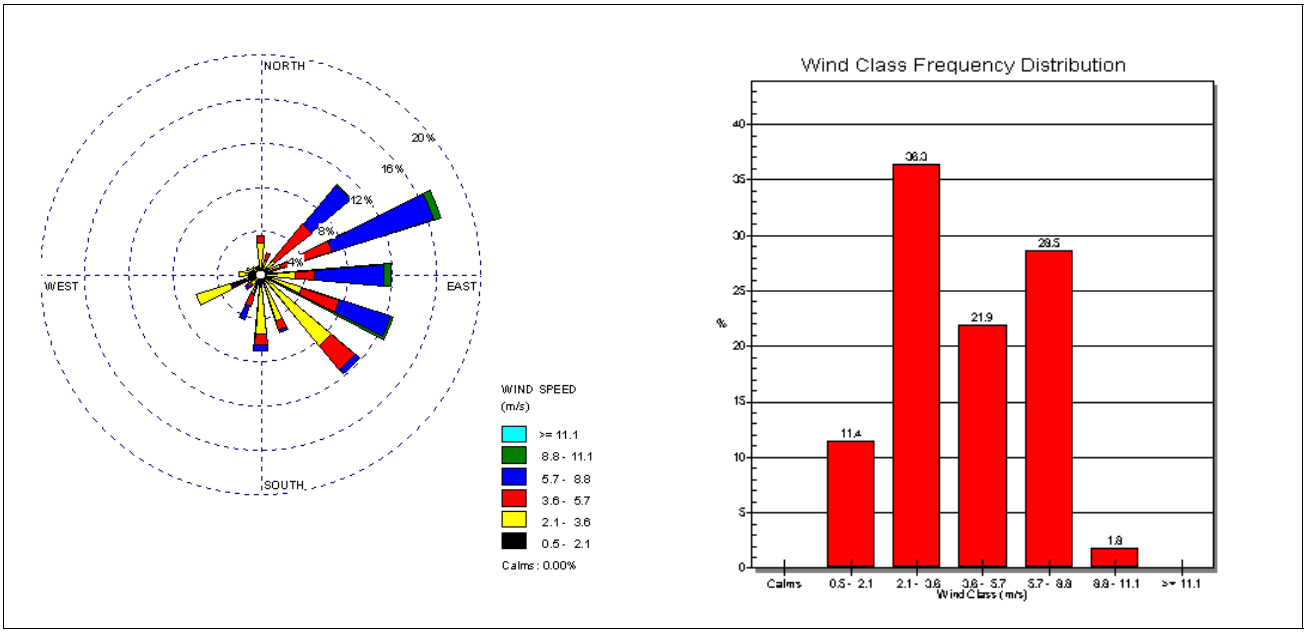

Figure 3: Wind Rose and Frequency Distribution for the Monitoring Period

3.3 PROJECT SPECIFIC MONITORING RESULTS

3.3.1 Scope of the Monitoring

The various sources at the Port of Townsville produce a range of gaseous and particulate emissions. Monitoring for a range of gaseous pollutants, including nitrogen dioxide, sulphur dioxide and hydrocarbons, is not routinely undertaken in the Townsville Port area. To provide further information about the existing ambient air quality at the Project Site and in the surrounding region, project specific monitoring was undertaken by ANE for oxides of nitrogen (NO_x), sulphur dioxide (SO_2) and hydrocarbons (methane, non-methane and total hydrocarbons). This monitoring was undertaken continuously and operated from July 2007 – October 2007. All monitoring was undertaken in accordance with the relevant Australian Standards and the Queensland EPA Air Quality Sampling Manual.

The monitoring was undertaken to supplement available monitoring data regarding the existing ambient environment during normal Port operations. Discussions with the Port have identified that Port operations while the monitoring took place were considered to be normal with vessels both importing and exporting product on a regular basis.

3.3.2 Instrumentation

The monitoring of ambient air quality at the ANE monitoring station at Berth 10 of the Townsville Port involved the installation of a continuous automatic monitoring station including automated data logging, download and calibration. Table 3.1 presents a summary of the monitoring equipment installed at the station for the duration of the monitoring project.

Table 3.1: SUMMARY OF MONITORING EQUIPMENT

Instrument	Model	Serial Number	Range
Horiba HC Analyser	APHA-350E	203002	10 ppm
TAPI NO_x Analyser	200E	1882	500 ppb
TAPI SO_2 Analyser	100E	78	500 ppb
TAPI Dilution Calibrator	700	127	-
TAPI Zero Air Generator	701	1625	-

In addition, a number of gas cylinders were installed on an external gas platform enclosure at the monitoring station. These included calibration gases for the hydrocarbons, NO_x and SO_2 analysers as well as hydrogen gas fuel for the hydrocarbon analyser. Table 3.2 presents a summary of calibration gas cylinders installed along with details of the NATA certified contents of each cylinder.

Table 3.2: CALIBRATION GAS DETAILS

Cylinder Serial Number	Manufacturer	Concentration	NATA Certified Calibration Expiry Date
TD471	BOC	Methane (CH4) = 798 ppm +/- 16 ppm	26/06/2011
3BM8343	BOC	Nitric Oxide (NO) = 50.4 ppm +/- 1.6 ppm Total Oxides of Nitrogen (NO_x) = 50.4 ppm Sulphur Dioxide (SO_2) = 49.9 ppm +/- 1/5 ppm	18/07/2009

3.3.3 Sampling Methodologies

The monitoring station is located at the end of Berth 10 (see Figure 9 of the AQA), an active berth, in close proximity to a range of Port activities. Analysers for continuously measuring nitrogen oxide, sulphur dioxide and both methane and non-methane hydrocarbons were installed. The station was established in late July 2007 and operated until October 2007.

All continuous gaseous monitoring was undertaken in accordance with the Australian Standard sampling methodologies as presented in Table 3.3.

Table 3.3: SAMPLING STANDARDS ADOPTED FOR CONTINUOUS GASEOUS MONITORING

Pollutant	Standard / Method
Methane, Non-methane and Total Hydrocarbons	AS 3580.11.1-1993 Methods for sampling and analysis of ambient air - Determination of volatile organic compounds - Methane and non-methane volatile organic compounds - Direct-reading instrumental method
Sulphur Dioxide	AS 3580.4.1-1990 Methods for sampling and analysis of ambient air - Determination of sulfur dioxide - Direct reading instrumental method
Oxides of Nitrogen	AS 3580.5.1-1993 Methods for sampling and analysis of ambient air - Determination of oxides of nitrogen - Chemiluminescence method

3.3.4 Calibration Procedures

The monitoring station was equipped and set up to undertake daily span and calibration checks on each of the instruments. These daily checks provide a check on the response of the instrument and allowed checks for malfunctions to be undertaken on a routine basis. Where anomalies were identified in the daily span check data, equipment operation was investigated and manual calibrations undertaken where necessary.

In addition to the daily automated zero and span checks, monthly on site calibration of each of the instruments was also undertaken. These calibration events included the completion of a zero, span and operational parameter check. In addition consumables including filters and drying agents were also replaced during these calibration events. Table 3.4 presents a summary of the dates of calibration for each of the monthly calibration events.

Table 3.4: SUMMARY OF MONTHLY CALIBRATION CHECKS

Date of Calibration	ANE Team Member	Notes
07/08/2007	MDR	▪ All parameters within spec. ▪ Span and calibrations undertaken. ▪ Consumables replaced
20/09/2007	MDR	▪ All parameters within spec. ▪ Span and calibrations undertaken. ▪ Consumables replaced
30/10/2007	MDR	▪ All parameters within spec. ▪ Span and calibrations undertaken. ▪ Consumables replaced ▪ Equipment decommissioned

3.3.5 Data Recovery Rate

Table 3.5 presents a summary of data collection rates for each of the monitoring instruments throughout the monitoring period. As can be seen from the data presented, data was captured for all instruments for greater than 80 % of the time with the exception of sulphur dioxide. For sulphur dioxide data capture rates were 73 % during the monitoring period.

Table 3.5: SUMMARY OF DATA COLLECTION RATES FOR MONITORING PERIOD

Analyser	Dates of Monitoring	Data Completeness
Oxides of Nitrogen (200E)	27/07/07 - 30/10/07	88 %
Sulphur Dioxide (100E)	27/07/07 - 30/10/07	73 %
Methane, Non-methane and Total Hydrocarbons (APHA-350E)	19/07/07 - 15/10/07	82 %

3.3.6 Monitoring Results

3.3.6.1 Oxides of Nitrogen

Table 3.6 presents a summary of measured nitrogen dioxide concentrations during the monitoring period. The results of the monitoring confirm that throughout the measurement period, maximum concentrations of nitrogen dioxide were well below both the 1 hour and 3 month average air quality goals. The measured concentration represents levels typical of other residential areas in Queensland.

Table 3.6: SUMMARY OF MEASURED NITROGEN DIOXIDE CONCENTRATIONS (ppm)

Averaging Period	Statistical Level	Measured Concentration	Criteria
1-hour Average	Maximum Concentration	0.032	0.12 (1-hour Average)
	90th Percentile Concentration	0.006	
	70th Percentile Concentration	0.003	
3-month Average	-	0.002	0.03 (Annual average)

3.3.6.2 Sulphur Dioxide

Table 3.7 presents a summary of measured sulphur dioxide concentrations during the monitoring period. The results of the monitoring confirm that throughout the measurement period, maximum concentrations of sulphur dioxide were below both the 1 hour, 1 day and 3 month average concentrations. For 1 hour concentrations the maximum recorded concentration represented 86 % of the ambient criteria. Review of the data, however, confirms that these elevated concentrations were not regular occurrences with 90 percent of the measured concentrations below 0.75 % of the criteria. The results of the monitoring for longer term averages are noted to be well below the criteria levels.

Table 3.7: SUMMARY OF MEASURED SULPHUR DIOXIDE CONCENTRATIONS (ppm)

Averaging Period	Statistical Level	Measured Concentration	Criteria
1-hour Average	Maximum Concentration	0.1724	0.20 (1-hour Average)
	90th Percentile Concentration	0.0015	
	70th Percentile Concentration	0.0001	
1-day Average	Maximum Concentration	0.0258	0.08 (1-day Average)
	90th Percentile Concentration	0.0015	
	70th Percentile Concentration	0.0003	
3-month Average	-	< 0.0001	0.02 (Annual average)

3.3.6.3 Methane and Non-methane Hydrocarbons

Table 3.8 presents a summary of measured hydrocarbon concentrations during the monitoring period. The results of the monitoring confirm that throughout the measurement period, maximum concentrations of non-methane hydrocarbons were either at or below the method detection limits (0.1 ppm) for 90 percent of the monitoring period.

Table 3.8: SUMMARY OF MEASURED HYDROCARBON CONCENTRATIONS (ppm)

Averaging Period	Statistical Level	Methane	Non-Methane	Total Hydrocarbons
1-hour Average	Average Concentration	1.7	0.0	1.7
	90th Percentile Concentration	2.1	0.1	2.1
	70th Percentile Concentration	1.9	0.0	2.0

4 CONCLUSIONS

The Townsville Ocean Terminal (TOT) project site (the Project Site) is located on and adjacent to the existing Townsville foreshore and incorporates the existing Port Western Breakwater and the Northern (Offshore) Breakwater, the existing perimeter of the land around the Townsville Hotel and Casino Complex and the Townsville Entertainment Centre.

In response to the EIS prepared for the TOT Project a number of key stakeholders have raised issues regarding the Air Quality Assessment (AQA). The focus of these comments is varied although most respondents have identified that the meteorological conditions and activities considered by the air quality monitoring undertaken for the project is not considered to be adequate. The AQA provided a summary of available monitoring data at the time of submission. Since that time further monitoring data has been collected with a summary of the methodology and results of the monitoring presented in this report.

Continuous monitoring of gaseous concentrations of oxides of nitrogen, sulphur dioxide and hydrocarbons (methane and non-methane) has been undertaken for a three month period. Meteorological conditions and Port operations throughout this period indicate that the results of the monitoring are likely to be representative of typical concentrations at the Project Site.

Overall, the results of the monitoring undertaken at the Berth 10 monitoring station are within the relevant air quality goals and criteria.

APPENDIX A

GLOSSARY OF TERMS

APPENDIX A: GLOSSARY OF AIR QUALITY TERMINOLOGY

Term	Definition
Conversion of ppm to mg/m^3	Where R is the ideal gas constant; T, the temperature in kelvin (273.16 + T°C); and P, the pressure in mm Hg, the conversion is as follows: $\mu g\ m^{-3}$ = (P/RT) x Molecular weight x (concentration in ppm) = $\frac{P \times \text{Molecular weight} \times (\text{concentration in ppm})}{62.4 \times (273.2 + T°C)}$ For the purposes of the air quality assessment all conversions were made at 25℃.
g/s	grams per second
mg/m^3	milligrams (10^{-3}) per cubic metre. Conversions from mg/m^3 to parts per volume concentrations (ie, ppm) are calculated at 25 degrees Celsius as required by the SEPP(AQM).
$\mu g/m^3$	micrograms (10^{-6}) per cubic metre. Conversions from $\mu g/m^3$ to parts per volume concentrations (ie, ppb) are calculated at 25 degrees Celsius.
ppb	parts per billion.
ppm	parts per million.
VOC	Volatile Organic Compounds. These compounds can be both toxic and odorous.
PM_{10}, $PM_{2.5}$, PM_1	Fine particulate matter with an equivalent aerodynamic diameter of less than 10, 2.5 or 1 micrometres respectively. Fine particulates are predominantly sourced from combustion processes. Vehicle emissions are a key source in urban environments.
50th percentile	The value exceeded for 50 % of the time.
NO_x	Oxides of nitrogen – a suite of gaseous contaminants that are emitted from road vehicles and other sources. Some of the compounds can react in the atmosphere and, in the presence of other contaminants, convert to different compounds (eg, NO to NO_2).
NO_2	Nitrogen dioxide – one of the group of NO_x compounds that can form through chemical interactions in the atmosphere following emission from the source.